Simulation and Practical Realization of A 24-Pair Electronic Continuity Test Circuit for MSAN ZTE

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***Abstract*— The continuity test of a telephone line is a technique used very often by every Telecom site engineer. Continuity refers to communication that does not face any interruption. Very often, the continuity measurement takes place during troubleshooting to ensure that the lines are intact. The work presented in this paper is based on the principle of MDF continuity rule lines for MSAN site. It presents the practical realization of a continuity tester circuit to verify several telephone lines simultaneously, specifically 24 pairs (24 subscribers) at the same time. Our solution suggested for making troubleshooting in one of the outages/ malfunctions more flexible and fluid in terms of intervention and time for repair. A case study involving 18 sites in two different regions in Algeria, Constantine (without circuit) and El Oued (with circuit) was conducted and the results showed there was a gain ratio estimated at about 338/1361 (Min).**

***Index Terms*—Electrical Continuity; MDF; MSAN; Dispatcher; ZTE.**

Nomenclature

AT	Algeria Telecom
DC	Direct Current
DSLAM	Digital Subscriber Line Access Multiplexer
IDF	Intermediate Distribution Frames
LED	Light Emitting Diode
MDF	Main Distribution Frame
MIN	Minutes
MSAN	Multiservice Access Node
NGN	Next Generation Network
ODT	Operator Display Terminal
PCB	Printed Circuit Board
PIC	Programmable Integrated Circuit
PSTN	Public Switched Telephone Network
RTD	Regional Terminal Display
TMDF	Trunk Main Distribution Frame
ZTE	Zhongxing Telecommunication Equipment

I. INTRODUCTION

The commonly known traditional PSTN networks are being replaced by so-called the new generation networks (NGN) [1, 2]. Consistent with the transition from analogue to digital, the change, which has the same magnitude and scale and spread over time, is necessary due to the growth of new services and customer needs. The exploration of new concept would be the reason to merge data and voice in order to create a single network that would offer, in terms of advantage, less maintenance and security constraints and very convenient communication rates. After each installation of an MSAN, the engineers in charge must check the connection between the subscriber and this equipment, and ensure that each subscriber is correctly connected to the appropriate service card through a multimeter tester that allows the continuity of a single pair electrical signal to be tested at the MDF [3, 4].

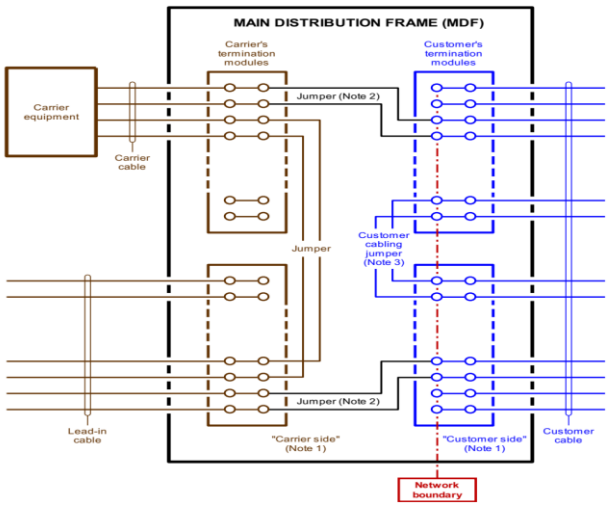

Figure 1: Example of Functional elements of a customer MDF [Figure J18 of AS/CA S009:2013] [5].

The MDF is an end inside the nearby phone trade, where the trade hardware and terminations of neighborhood circles are associated by jumper wires at the MDF. All the copper link sets providing administrations through client phone lines are ended at the MDF and disseminated through the MDF to the gear inside the nearby trade, for example repeaters and DSLAM. Links to the middle circulation outlines (IDF) end at the MDF. Trunk links may end on the equivalent MDF or on a different trunk principle dissemination outline (TMDF). Like other appropriation outlines, the MDF gives adaptability in doling out offices at a lower cost and a higher limit than a fix panel. The most basic sort of enormous MDF is a long steel rack available from the two sides. On one side, the end squares are orchestrated on a level plane at the front of rack. Jumpers lie on the racks and experience a protected steel band to run vertically to the other end poles that are orchestrated vertically. There is a loop or ring at the crossing point of each level and every vertical one. Introducing a jumper generally requires two laborers, one on either side of the MDF. The racks are shallow enough to enable the rings to be inside the arm's span, yet the laborers like to drape the jumper on a hook on a shaft so their accomplice can pull it through the ring. A fanning strip at the back of every end square keeps the wires from covering each other terminals. With this restrained organization, the MDF can hold over a hundred thousand

jumpers, with many of them changed each day, for quite a long time without tangling. Generally, the MDF holds phone trade and defensive gadgets including heat curls and capacities as a test point between a line and the trade hardware [5, 6, 7].

To perform the test, the two subscriber lines leaving the MDF must be looped and the multi-meter fixed in the position of this pair at the NE; if this tester rings, it means that there is no discontinuity in this link and that the subscriber is well connected to his card [8, 9, 10].

Otherwise, when it is proven that there is a problem of a cable cut and the subscriber is badly fixed in MDF, the method called classic and traditional will take a long time to repair as it tests only one pair at a time in order to ensure the continuity of all pairs. To address this issue, we proposed a less expensive and more reliable technique to build an electronic circuit that allows us to test the continuity of the 24 pairs (24 subscribers) simultaneously at ZTE [11]. Before starting the simulation and practical part, it is pertinent to explain some essential entities for this kind of network called MSAN [12, 13, 4].

A. Dispatchers

Dispatcher, usually called MDF is a very important piece of equipment in the MSAN site. This entity ensures the correspondence between the subscriber lines and the MSAN equipment. This MDF is composed of two parts: The first part of the rules that supports all subscriber lines is called TID, and the second part, called the head, is connected to the subscriber strips that go to the other nodes of the network (distribution, transmission, etc.) [4, 6].

B. Rulers

Subscribers belonging to an MSAN are all written in its rules; an MSAN of 1000 subscribers contains 1000 pairs of copper wires either for voice or data or for both sets. To differentiate between the copper pairs, it is necessary to us well-defined and precise color code. Each of the eight pairs forms a group. Table1 shows the four different colored ropes used to distinguish between the groups.

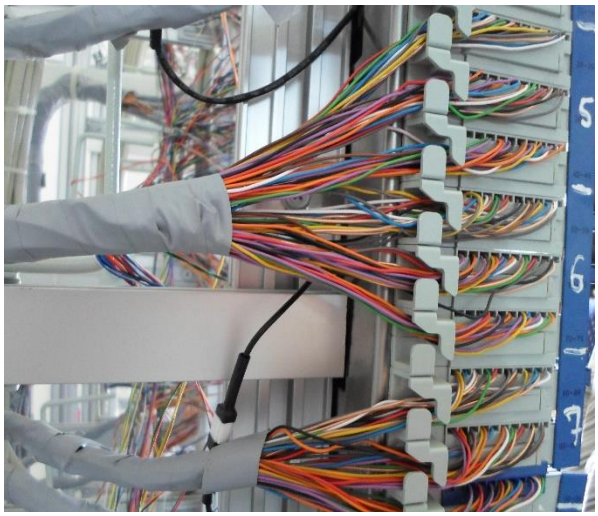

Figure 2: Horizontal Rulers

C. The head

The head is the part of the distributor that connects the subscriber to the network. It is composed of a set of groups of primers and copper pairs organized as follows:

- 7 pairs make up a primer.
- 4 primers make up a group.
- 4 groups make up a 112 pair head.

The heads of a distributor used their own color code:

Table 1
Head color codes [4]

GROUP1	White + Colorless Blue + Grey Yellow + Colorless Maren + Grey Black + Colorless Red + Grey Green + Colorless White + Orange Blue + Purple Yellow + Orange	GROUP2	White + Grey Blue + Colorless Yellow + Grey Maren + Colorless Black + Grey Red + Colorless Green + Grey White + Purple Blue + Orange Yellow + Purple
GROUP3	Maren + Violet Black + Orange Red + Purple Green + Orange	GROUP4	Maren + Orange Black + Purple Red + Orange Green + Purple

II. Electrical Continuity Tests And Simulation

Electronic circuits are built by connecting the components together. This connection can be direct when the wires of the two components are turned. Alternatively, they can be connected via a trace on a printed circuit board.

In any case, it is essential that some points are connected to each other, while the other points are isolated.

A continuity tester allows us to quickly check if the points to be connected are really connected, and if the points to be isolated are isolated.

A. Overview of ISIS and ARES Proteus software

Proteus is a software suite designed to edit and simulate electrical diagrams, developed by Lab center Electronics. Proteus is composed of two main tools:

ISIS: a tool for creating, editing and simulating electrical diagrams [14, 15].

ARES: a tool for the creation of printed circuits [15].

With additional modules, ISIS is also able to simulate the behavior of a microcontroller (PIC, Atmel, 805) and its interaction with the components that surround it.

B. Generality on the electronic components used

The resistance value is calculated using a clear, quantified code or a color code, in which its unit is the symbol Ohm according to Ω. The resistance is used in some cases to regulate the current intensity and can also be used to produce heat facilitated by the joule effect provided during the transmission of the electrical signal in thermal energy.

Bipolar transistor or junction transistor is a semiconductor composed of two PN junction diodes: One is placed directly and the other is placed inversely. They are used as controlled switch, amplifier, voltage stabilizer and signal modulator. There are two types of bipolar transistors: One is called NPN and the other is PNP. Both operate using three main layers (Emitter, base, collector). Our circuit is made by using a BC547 NPN transistor.1, ARM, HC11...) and its interaction with the components that surround it.

The diode is a semiconductor dipole generally manufactured by silicon. It is composed of two anode (A) and cathode (K) electrical terminals in a circuit that includes a diode, in which the current can only pass through one direction while the direction of connection is of great importance in a diode circuit. The different types of diodes

are used for different applications in circuits electronic. For example, the voltage a Zener diode is used to rectify an alternating voltage as a rectifier diode. In our case, we used a LED to indicate whether the electrical continuity of the wire is checked or not.

Printed circuit board is a support, in which an electronic circuit is printed. It is usually made of copper, whereby the electrical components are placed on this support.

C. Creation of continuity tester circuit

Before starting a project, we must first preload and put on hold the different components we plan to use. The available components are grouped into libraries classified by theme.

In order to make a continuity tester circuit of 24 pairs of copper wires, we have chosen a simple electrical assembly consisting of nine V DC power source, two resistors of 1 KΩ, a bipolar transistor (NPN) of the BC547 type and a LED-Green.

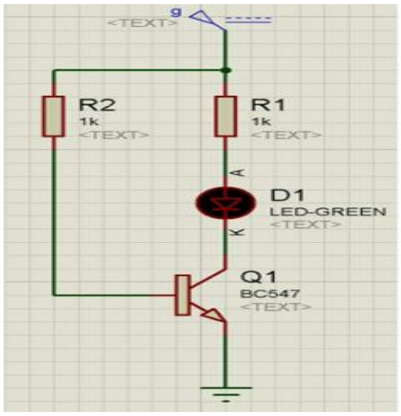

Figure 3: Continuity tester created by ISIS Proteus

We used ISIS Proteus to simulate our assembly. If there is a continuity between the resistor and the transistor base, the LED diode will light up green Otherwise, it does not light up.

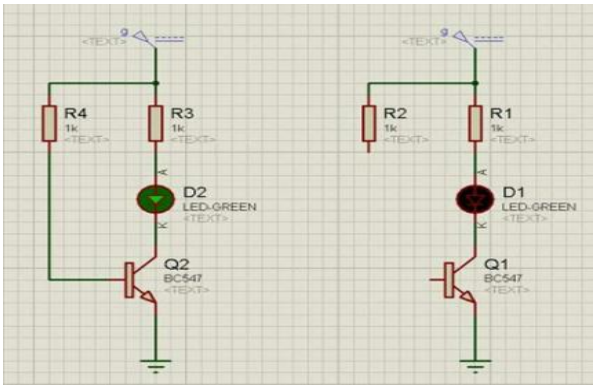

Figure 4: Continuity tester assembly

In this arrangement, the transistor operates in a switching mode; it is assimilated to a switch between collector C and emitter E, controlled by base B. In this mode, there are two possible states:

- Passed or saturated state: when a low current I_b is passed, the current I_C will pass from the collector to the transmitter (switch closed).
- The blocked state: in case the current I_b is zero, no current I_C will pass (switch open).

After having tested the proper functioning of this assembly, we tried to build our 24 pair testers by connecting 24 times the previous circuit in series. The circuit obtained will be treated by ARES Proteus, following with the printing of a circuit board.

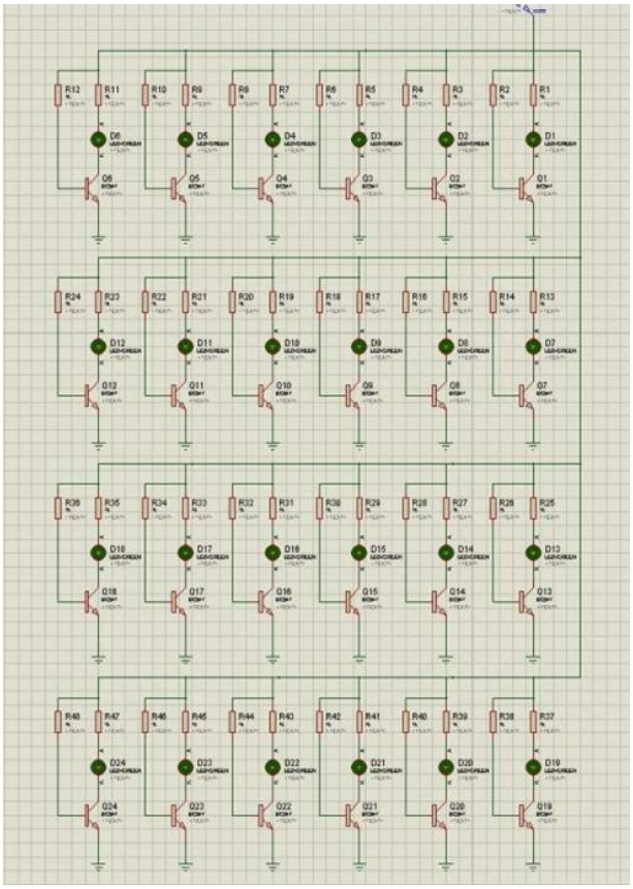

Figure 5: Circuit capture on ISIS Proteus tool

Proteus Professional's ISIS software is mainly used to simulate these diagrams, which makes it possible to detect certain errors as early as the design stage. Indirectly, the electrical circuits designed with this software can be used in documentation because the software allows the controlling of the majority of the graphic aspect of the circuits [16].

Figure 5 shows a detailed view of the connectivity between our components.

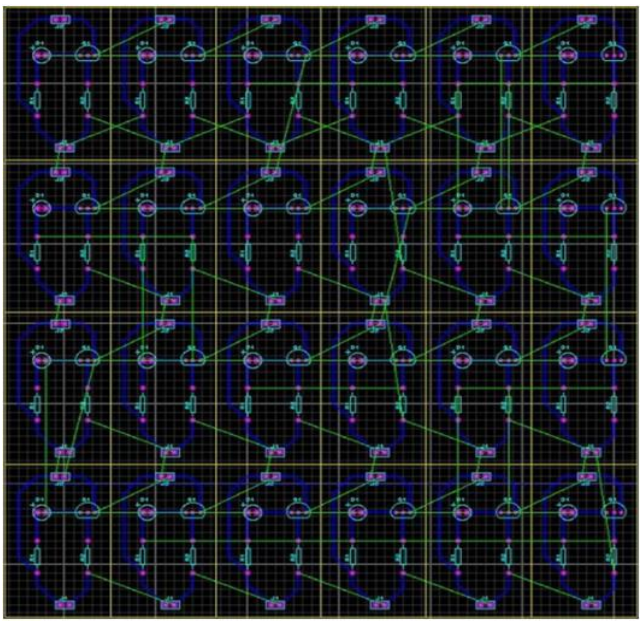

Figure 6: Circuit capture on ARES Proteus tool

ARES software is an editing and routing tool that perfectly complements ISIS. An electrical diagram made on ISIS can then be easily imported on ARES to create the PCB of the electronic card [16]. Although editing a printed circuit board is more efficient when done manually, this software automatically places components and performs routing automatically. In the same way, we will present our circuit from the ARES software, as shown in Figure 6.

After implemented our solution in ISIS and ARES software, it is time to put it into practice. The following figure shows a capture of developed circuits during the test using a voltage generator:

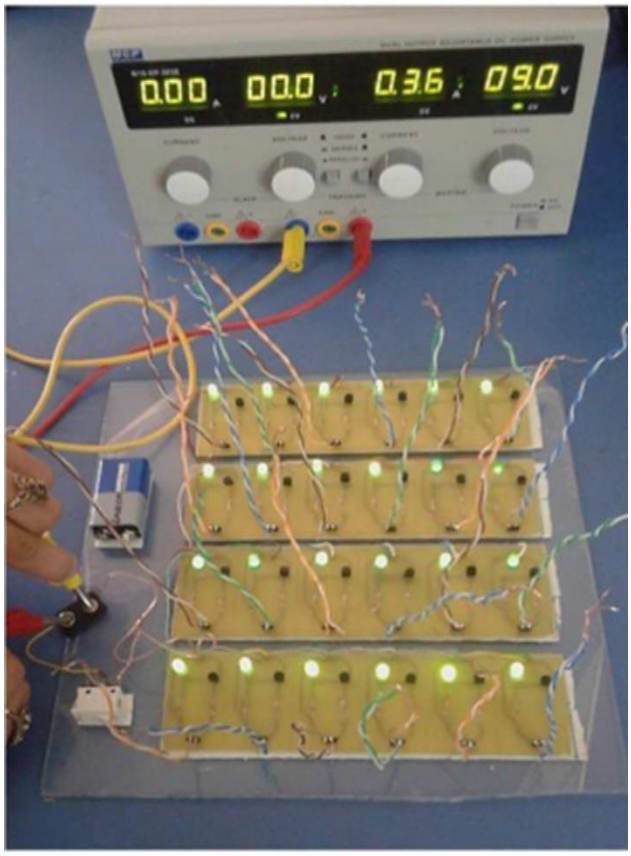

Figure 7: real capture of our circuit

III. CONCLUSION

Site identification can be reviewed as the possibility of evaluating Algeria Telecom's premises in order to ensure and check that the sites are well adapted to the installation of the proposed equipment. The points that are reviewed during the site survey visit are: Access to the site, to the rooms; Power supply availability; Environmental conditions; Space and location for the proposed equipment; Security constraints; Peripheral equipment; Cabling constraints; and the linkage of sites. In a central office preparatory phase, ZTE will realize a linkage at the MDFs level as well as the verification of the continuity of each subscriber line to be switched (and the update of the database provided by AT).

This circuit is designed to find an optimal and economical solution, instead of testing line by line. Based on the new technique, we can test 24 lines simultaneously; hence allowing us to save more time and minimize the subcontracting budget of Huawei or ZTE responsible for performing this test step. With the help of this tour, we will optimize the work from one day or more to half a day.

To validate our assertion, we compared the MDF ringing time for two regions of MSAN sites (without /with our circuit): The first 18 sites are located in the city of Constantine (without circuit), Algeria, and the second region is El Oued (with circuit), Algeria. The approximate ringing time for these two regions is as follows:

Table 2
Two tables comparing ring times for 18 different MSAN sites in different regions, the first without circuit and the second with our solution circuit.

RTD	ODT	Subscribers	Site IP-MSAN	IP H248 172.29.104. /24	IP MNG 172.29.204. /24	MDF sonnage (Min)	METRO SWITCH
CONSTANTINE	OUM EL BOUAGHI	750	AIN FAKROUN	58	58	70	AIN FAKROUN
			CDC AIN BEIDA	41	41	75	CAH AIN BEIDHA
			NOUVELLE VILLE	42	42	74	
			EIHAWA ETTALLEK	43	43	80	
			EL KAHINA	44	44	79	
			KANOUNI TAYEB	45	45	76	
			BEN AJEL TAHER 1	48	48	71	
			BEN BEN BOULAID	49	49	70	
			BEN AJEL TAHER 2	50	50	72	
			EL HRAKTA	51	51	85	
			1 ER NOVEMBRE	56	56	84	
			EI AMEL 1	46	46	76	EL MOUSTAKBEL
			EI AMEL 2	47	47	70	
			ESSADA	52	52	89	
			EL MOUSTAKBEL	53	53	74	
			ZIDOUNI AMARA	54	54	73	POIDS LOURDS
			POIDS LOURDS	55	55	72	
			IBN ROCHD	57	57	71	
						1361	*TOTAL (Min)*

RTD	ODT	Subscribers	Site IP-MSAN	IP H248 172.29.129. /56	IP MNG 172.29.229. /56	MDF sonnage (Min)	METRO SWITCH
EL OUED	OUARGLA	750	HKH ZEGHBIATE	58	58	15	ZEGHBIATE
			DANDOUGA	41	41	20	REGUIBA
			TARFAYET SALAH	42	42	18	
			DJEIDEIDA	43	43	17	
			HOTEL DE FINANCE	44	44	15	
			REGUIBA	45	45	24	
			AGUILA	48	48	23	
			M'RARA	49	49	18	
			ABADLIA	50	50	12	
			AYAICHA	51	51	19	
			DEBIA EST	56	56	20	
			AKFADOU	46	46	21	DEBILA
			DRIMINI	47	47	22	
			DEBILA	52	52	19	
			HKH HAMAISSA	53	53	17	
			HKH CHOUAIHA	54	54	16	HKH
			HKH 1 NOVEMBRE	55	55	19	
			DOKAR	57	57	23	
						338	*TOTAL (Min)*

Based on the validation results, we have drawn several conclusions. There are numerous reasons why a phone line can come up short, particularly with the corrupted made copper wires arrange framework. The more seasoned the property is, the more terrible the circumstance is probably going to get, particularly if the quality work is not done during the underlying establishment.

This regularly accepted future specialists and temporary workers should set aside cash; Otherwise, it is essentially unimaginable for them to build up the cabling guidelines. Not exclusively, there could be the interior wiring issues, however a phone line can be influenced by imperfect conditions on the system side of the association. To identify where the issue is and who is liable for illuminating it, some essential tests should be performed to solve the issue. Therefore, for future work, we suggest for a plan of hardware that will identify establishment disappointments, for instance the discovery of awful terminations and cross conduits just as the issue of female plug connectors. In this case to tackle the phone issues, extra attention should be given during the examinations.

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REFERENCES

[1] B. Handley, "Multi-Service Access Nodes (MSANs): Gateways to Next-Generation Network (NGN)," *Fujitsu scientific & technical journal*, (42) 4, Oct 2006, pp. 432-438.

[2] M. H. Hasanov, B. G. Ibrahimov, N. T. Mardanov, "Research and Analysis Performance Indicators NGN/IMS Networks in the Transmission Multimedia Traffic," *Wave Electronics and its Application in Information and Telecommunication Systems (WECONF)*, Saint-Petersburg, Russia, 2019, pp. 1-4. doi: 10.1109/WECONF.2019.8840117.

[3] A. Joachim, "Multi-Service Access Node: Soft switches ITSF ROM," *Telekom Austria*, 2009.

[4] S. Ghouali, M. Feham, R. Merzougui, "An integrated hardware/software in Algeria Telecom access layers NGN model: MA5600T and C300M Shelfs MSAN's solutions," *Photonics Letters of Poland*, 11(2), 2019, pp. 32-34, doi: 10.4302/plp.v11i2.899.

[5] Telstra Corporation Limited (ABN 33 051 775 556), 26/08/2013 Issue 2–Final, Document NO. 017153A08, Telstra Requirements For Customer MDFS.

[6] P. Albijanić, M. Tepšić," Comparision and characteristics of ADSL service Installation concepts using remote Co MDF-mounted splitters," *Infoteh-ahorina* Vol. 9, Ref. B-III-12, March 2010, pp. 299-303.

[7] S. Ooghe, N. Voigt, M. Platnic, T. Haag, S. Wadhwa, "Framework and Requirements for an Access Node Control Mechanism in Broadband Multi-Service Networks," *Internet Engineering Task Force (IETF)*, May 2010.

[8] D. C. Eddine, "Presentation MSAN type ZTE (MSG 5200 & C300M)," 2015. https://fr.scribd.com/doc/269512008/Msan.

[9] DSM-2128 IP DSLAM and MSAN (Multi Service Access Node), Smart solutions for smart networks, Sept 2018.

[10] Huawei, "MSAN MA5600T Basic Configuration," Issue 1-00, 2010.

[11] ZTE XA10 C300, Optical Access Convergence Equipment Confguration Manual (CLI), Serial Number: SJ-20130520164529-00, 2013-06-30 (R1.0), RL: http://support.zte.com.c.

[12] Huawei, "SmartAX MA5600T/MA5603T/MA5608T Multiservice Access Module: Commissioning and Configuration Guide," V800R015C10, Issue 01, 2014-10-30.

[13] S. Hassane, "Implementation de la solution Dual Homing pour la diversification des liens Uplinks du MSAN MA5600T au sein du reseaux metro Ip d'IAM," Ecole Nationale des Sciences Appliquées–Tanger, 2014.

[14] http://www.elektronique.fr/logiciels/proteus.php, 2019-03-19.

[15] J. Chen, Shujie Yang, "Application of Proteus software in MCU teaching;" Second International Conference on Mechanic Automation and Control Engineering, 2011, doi:10.1109/mace.2011.5988496.

[16] T. M. Lamine, "Cours de Proteus Professional (ISIS & ARES)," *Magoe Technologie*, 2014, pp. 1-33.